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# ITWG Round Robin 3 - 24 Hour Report

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March 2, 2010

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This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

# **Nuclear Forensics International Technical Working Group (ITWG)**

## **Round Robin #3**

### **24-Hour Report**

Laboratory: Lawrence Livermore National Laboratory (United States of America)  
Code Name: Ural

Current Status: Categorization is complete. Both samples are weapons-usable, highly enriched uranium with a  $^{235}\text{U}$  isotopic abundance of  $94 \pm 2\%$  (1-standard deviation). Both samples are solid and pin-shaped, apparently metallic, but with a slightly oxidized appearance. Both samples are approximately 3 mm in thickness, 18 mm in length, but trapezoidal in cross-section (the short ends are 5 & 3 mm for Sample A and 6 & 4 mm Sample B). There is no information available yet that indicates whether the samples were from different sources.

Potential Issues: The current analytical plan calls for division of the solid samples into 4 pieces: one for radiochemical analysis, one for mass spectrometry analysis, one for metallurgical analysis, and one for archiving. However, the size and strength of these solid pieces could prove challenging to section in a manner consistent with nuclear forensics best-practices, including safety and contamination prevention.

#### Delivery Details

|   |                            |
|---|----------------------------|
| Shipment arrived at LLNL Materials Management:              | 09:30 AM/February 17, 2010 |
| Drum delivered to LLNL Nuclear Forensics Team:              | 11:30 AM/February 23, 2010 |
| Package Opened/Exercise Started/Chain of Custody Initiated: | 9:00 AM/February 26, 2010  |

#### Sample Identification

|          |            |  |
|----------|------------|--|
| Sample A | 3C19VLL6D7 | Chain-of-custody initiated as FSC-10-1-2 |
| Sample B | 3C19VLLDFJ | Chain-of-custody initiated as FSC-10-1-1 |

#### Initial Inspection and Photo Documentation

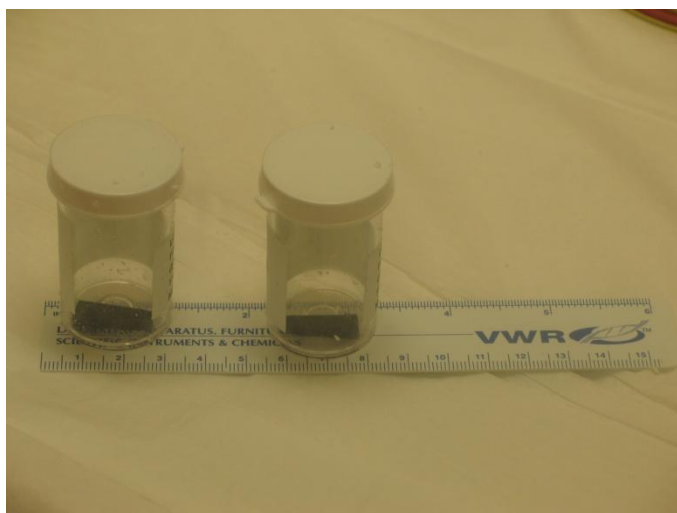
Both samples 10-1-01 and 10-1-02 were solid, pin-shaped samples. They were both nominally 3 mm in thickness, roughly trapezoidal in cross-section, 18 mm in length. Sample B (10-1-1) was approximately 6 mm at one end and 4 mm at the other end of the trapezoid, while Sample A (10-1-2) was approximately 5 mm at one end and 3 mm at the other end of the trapezoid. All surfaces appeared to have a slightly oxidized surface and otherwise appeared to be unfinished. In addition to standard photo documentation, we also took optical photomicrographs for each sample. These will appear in a later report.



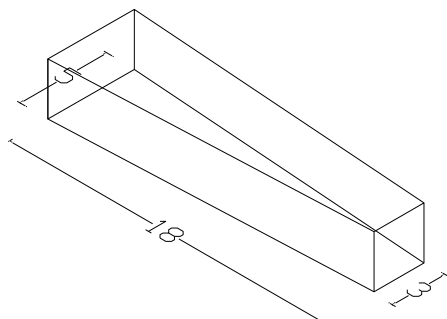
Shipping drum as received.



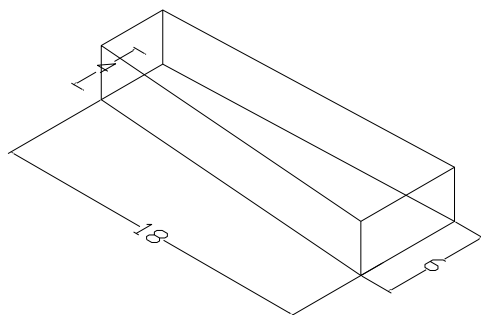
Material packaging.



Left: Sample B (10-1-1);  
Right: Sample A (10-1-2)



**Rough Dimensions of Sample A (FSC 10-1-2)**  
(dimensions in mm; thickness is 3 mm)



**Rough Dimensions of Sample B (FSC 10-1-1)**  
(dimensions in mm; thickness is 3 mm)

### Sample Mass

|          |        |                             |
|----------|--------|-----------------------------|
| Sample A | 10-1-2 | 5.0640 ± 0.0002 grams (k=2) |
| Sample B | 10-1-1 | 5.6196 ± 0.0002 grams (k=2) |

### Whole Sample Gamma Spectrometry Results

Note: Whole Sample Gamma Spectrometry performed for initial categorization only. We will obtain higher accuracy and precision from whole solution gamma spectrometry and inductively coupled plasma/mass spectrometry. Uncertainties are expressed as relative standard deviations with k=2.

ITWG exercise, 2/28/10, samples 100226

Results of 1-hour gamma-spec at 29 cm

|               | FSC-10-1-1<br>Sample B |     | FSC-10-1-2<br>Sample A |     |
|---------------|------------------------|-----|------------------------|-----|
| atom ratios   |                        |     |                        |     |
| 232U/235U**   | 1.58E-10               | 13% | 1.22E-10               | 17% |
| 233U/235U     | < 1.0e-4               |     | <1.3e-4                |     |
| 234U/235U     | 3.37E-03               | 32% | 2.39E-03               | 48% |
| 238U/235U     | 5.82E-02               | 52% | 5.72E-02               | 66% |
| 237Np/235U \$ | 4.17E-06 \$            | 18% | 4.58E-06               | 21% |
| 231Pa/235U    | < 1.2e-7               |     | < 1.3e-7               |     |
| 239Pu/235U    | < 5e-5                 |     | < 1.1e-4               |     |

error bars are 2-sigma

\*\*assumes aged material where 228Th is in equilibrium with 232U

\$ bkg subtraction in limited area of spectrum was not great, value might increase by 5-10%

### Technical Interpretation

Note: Technical interpretations are technical judgments based upon current results and will evolve as more results are obtained.

- The material is HEU of (94 ± 2%) <sup>235</sup>U isotopic abundance. Sample A is approximately 5.1 grams and Sample B is approximately 5.6 grams. Therefore, the transportation of both Sample A and Sample B exceeded the statutes of Texmex. (Exercise Scenario)
- These initial isotopic results are more consistent with a 93 % isotopic assay, e.g., United States HEU, but one cannot rule out a 90 % isotopic assay, e.g., Soviet HEU (ITWG Round Robin 2 from Czech Republic), at the 2-sigma level either.
- The <sup>234</sup>U/<sup>235</sup>U ratio is quite low for material enriched through a gaseous diffusion or centrifuge process (typically around 1% or so). With improved analytical results (solution gamma spec and ICP-MS), we can better assess the potential isotopic enrichment method.

- The presence of  $^{232}\text{U}$  and  $^{237}\text{Np}$  indicates that some of the enrichment feed stock was irradiated in a reactor. The presence of Np is consistent with previous US HEU samples that we have analyzed.
- We have no information yet that indicates whether the samples were from different sources.